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RESEARCH ARTICLE

Rare grasshoppers (Orthoptera, Acridoidea) of the Baraba and Kulunda steppes (South Siberia)

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Abstract

The first list of the rare grasshoppers of the Baraba and Kulunda steppes is presented. Two sets of distribution data are compared: (1) for the first half of 20th century and (2) for 1972–2019. A series of digital maps was generated by MapInfo 12.03. The distribution patterns of several species, namely *Asiotmethis muricatus* (Pallas), *Notostaurus albicornis* (Eversmann), *Eremippus simplex* (Eversmann), *Myrmeleotettix antennatus* (Fieber), *Gomphocerippus rufus* (Linnaeus), *Mesasippus arenosus* (Bey-Bienko), *Mecostethus parapleurus* (Hagenbach), *Locusta migratoria* Linnaeus, did not change significantly. Four taxa (*Asiotmethis jubatus* (Uvarov), *Arcyptera fusca* (Pallas), *Stenobothrus carbonarius* (Eversmann), *Sphingonotus coerulipes* Uvarov) were relatively often in the first half of 20th century and nowadays they are extremely rare. Two species, namely *Megaulacobothrus aethalinus* (Zubovsky) and *Aeropedellus variegatus* (Fischer de Waldheim), were recently found near the south-eastern and north-eastern boundaries of the region respectively. There are also the type localities of *Asiotmethis jubatus* and *Mesasippus arenosus* in the Kulunda steppe.

Keywords

Acrididae, Caelifera, East Kazakhstan, Migratory locust, Pamphagidae, Russia

Introduction

Grasshoppers (Acridoidea) are well known as possible pests, especially in agricultural areas. However, this superfamily includes a lot of endemic and rare species

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deserving conservation measures, particularly in mountains of the Palaearctic region (Uvarov 1928; Sergeev 1992, 1998, 2010; Lockwood, Sergeev 2000). More than 450 grasshopper species are included in the IUCN Red List of Threatened Species (IUCN 2020) and many are on regional Red Lists/Books. In grassland regions of Eurasia and North America, some dense and extensive populations of grasshoppers may be observed, especially during outbreaks. This pattern is usually determined by high abundance of several widely distributed species. On the contrary, there are only a few endemics and some implicit areas of acridid diversity (Sergeev 1996, 1997). These weak acridid foci of diversity often coincide or overlap the areas of locust and grasshopper upsurges (Sergeev 1996, 1998). As a result, some serious problems related to population management of both common and rare species may arise.

The south-eastern part of West Siberian Plain is the territory where numerous outbreaks of locusts and grasshoppers' populations have been developed and where some rare acridid species occur. Besides, this territory has been significantly transformed by human activity, especially in the beginning and in the middle of the 20th century. Such regional and local transformations and/or also climate changes could and can result in some shifts in species and population distribution.

The first, but scarce data describing acridid diversity and distribution over the south-eastern part of West Siberian Plain were published in the 19th century, but more or less comprehensive studies of local grasshoppers started only in the 1920s (Tarbinskij 1925; Wnukowskij 1926; Bey-Bienko 1930a, 1930b, 1930c). Almost all data for the first half of the 20th century were analyzed and summarized by Berezhkov (1956). This allows us to compare changes in species distribution for the first half of the last century and for last several decades. The aim of this publication is to evaluate a general situation with rare acridid species in the Baraba and Kulunda steppes on West Siberian Plain.

Materials and methods

Original data were collected from 1979 until 2019 in the so-called Baraba and Kulunda steppes. This huge area borders the Irtysh River to the west and south-west, the Ob River to the east, and the Altay Mts. to the south-east. Its northern boundary is approximately defined by the 56th parallel north. Originally this territory was covered with grasslands (from meadows to dry steppes) and forests (mainly the birch and pine ones) (Isachenko 1985). However, the main part of the plains was transformed in agricultural lands (fields and pastures). Besides, there are some floodplains with meadows and forest patches, solonchaks, and swamps.

The peculiarities of acridid ecological distribution were characterized by quantitative and qualitative samples collected in natural and transformed ecosystems, usually in the middle of summer when adults were dominated. Samples captured during a fixed period of time were made in every habitat investigated (Gause 1930; Sergeev 1986, 1992). Using this method, insects were caught with a standard net

over a period of 10–30 minutes. Results for every habitat were recalculated for an hour. In many habitats, grasshopper densities were also counted on 25–100 arbitrarily placed plots 0.25 x 0.25 m (in some cases 0.5 x 0.5 m). After that the average density was estimated for every habitat investigated.

Some old materials, mainly from the field trips of Novosibirsk State University (1972–1977), were also used, but we tried to check and correct previous identifications. We used the Glonass/GPS navigators to determine geographical coordinates (see Appendix 1). For localities studied before 2000 we used Google Earth Pro (©Google, 2020) to get the same parameters. The main part of studied specimens is in the collections of Novosibirsk State University and the Institute of Systematics and Ecology of Animals (Novosibirsk). We obtained some data on general distribution of species from several main sources (Mistshenko 1972; Sergeev 1986, 1992; Latchininsky et al. 2002) and used the English names of several species published on the site "Grasshoppers of Europe" (2020).

We analyzed data from different sources for the first half of the 20th century (Tarbinskij 1925; Wnukowskij 1926; Bey-Bienko 1930a, 1930b, 1930c; Berezhkov 1956 et al.) and indentified geographic coordinates of almost all localities. In 1972–2019 data were collected in 81 localities (Fig. 1). For some reasons these localities were investigated in quite different manners: (1) Some plots were studied during several years; (2) Some plots were explored during one warm season but at least several different habitats were studied; (3) The others (mainly the zonal ones) were investigated once and for relatively short time (from about half an hour to one hour). We considered some species which have been collected only in a few localities (less than 5 %, i. e. less than 5 localities) as rare forms for last several decades.

Maps of species distribution were produced on the basis of geographic coordinates with MapInfo 12.03.

Results and Discussion

Family Pamphagidae Burmeister, 1840
Subfamily Thrinchinae Stål, 1876
Tribe Thrinchini Stål, 1876
Genus *Asiotmethis* Uvarov, 1943

***Asiotmethis muricatus* (Pallas, 1771)**
Pointed stone grasshopper
Figure 2

General distribution. SE European Russia, Kazakhstan, S West Siberia.

Local distribution and ecology. The species was (and is) very rare. It prefers habitats with scarce vegetation in the typical and dry steppes (commonly with some sagebrushes). *A. muricatus* is an early hatching grasshopper. Its adults can be usu-

ally observed in the first half of a summer. That explains, at least partly, its relative rarity, because here acridologists usually prefer to collect grasshoppers in the second part of a summer.

Remarks. Some old data concerning its distribution may belong to to the next species described only in 1926.

Asiotmethis jubatus (Uvarov, 1926)

Figure 3

General distribution. SE West Siberia (steppes), NE, E Kazakhstan, NW China (N Xinjiang).

Local distribution and ecology. This species was described as *Tmethis jubatus* Uvarov from the vicinities of Severnaya settlement, Slavgorod District, Omsk Province (now Severka settlement, Klyuchevsky District, Altai Krai (Altaj Region), Russia) (Uvarov 1926). In the first half of the 20th century *A. jubatus* was more or less common in the southern part of the Kulunda steppe (Berezhkov, 1956). Unfortunately, the species is absent in our collections from the region. However, it is relatively common in the semi-deserts of E Kazakhstan. It prefers habitats with

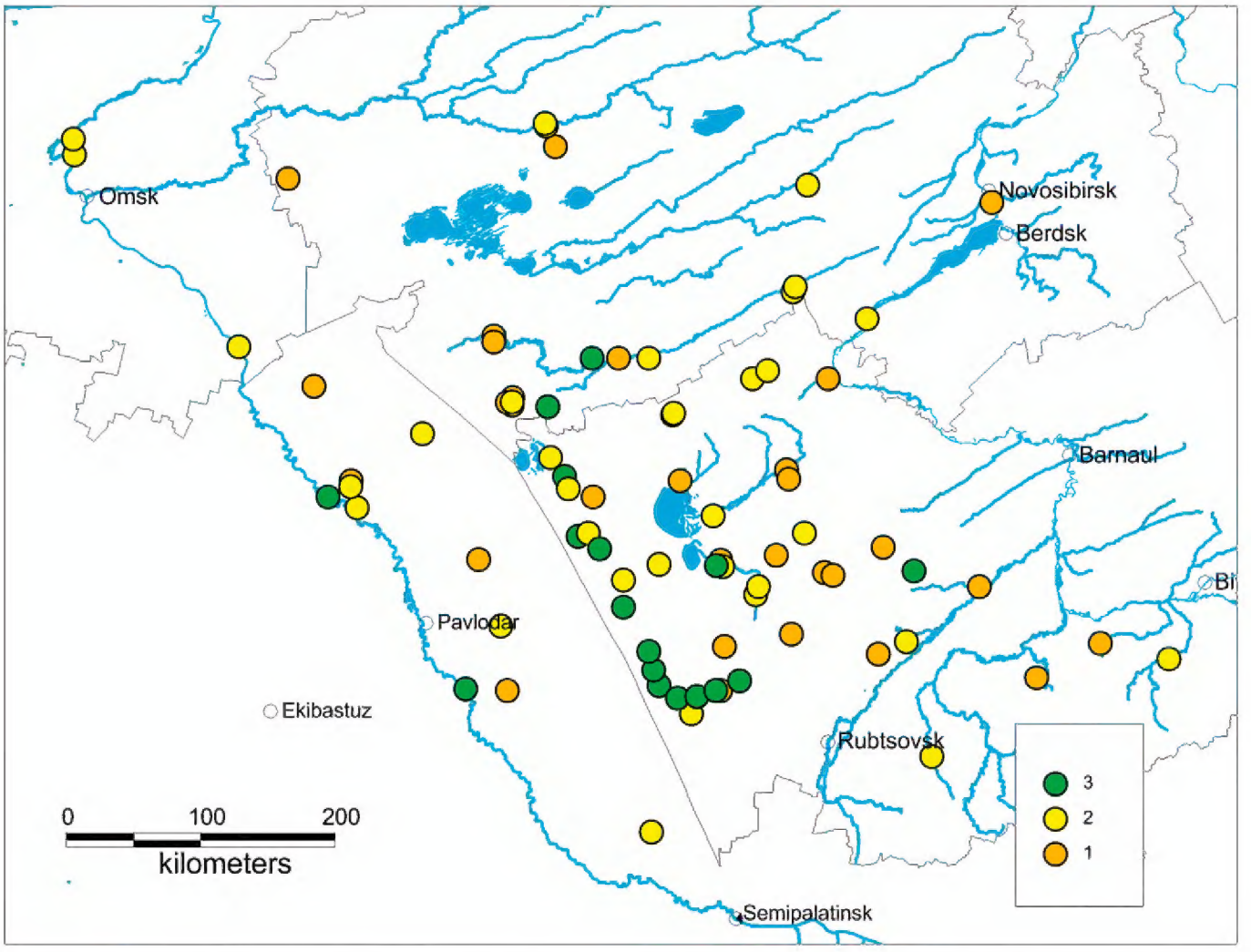


Figure 1. Localities: **1** – only one (mainly zonal) habitat were investigated once and for relatively short time; **2** – series of different habitats studied during one warm season; **3** – plots studied during several years.

scarce vegetation in the typical and dry steppes (commonly with some sagebrushes and halophytes) and some similar stony habitats in the mountain semi-deserts. *A. jubatus* is an early hatching grasshopper. Its adults can be usually caught in the first half of a summer. That explains, at least partly, its relative rarity, because here acridologists usually study grasshoppers in the second part of a summer. Besides, some habitats of this species could be destroyed or damaged during the co-called Virgin Lands campaign in the middle of the 20th century when huge steppe areas have been ploughed and many steppe remains have become overgrazed.

Family Acrididae MacLeay, 1821
Subfamily Gomphocerinae Fieber, 1853
Tribe Arcypterini I. Bolívar, 1914
Genus *Arcyptera* Audinet Serville, 1839

***Arcyptera fusca* (Pallas, 1773)**
Large banded grasshopper
Figure 4

General distribution. From the mountains of S Europe to Amur Region of Russia and to NE China; including Moldova, Ukraine, the southern part of European Russia, the Caucasus, Kazakhstan, S Siberia up to Sakha (Yakutia), Mongolia.

Local distribution and ecology. In the first half of the 20th century the species was found in many localities, chiefly in the forest-steppes and in the steppes with forest patches, because it prefers some meadows with broadleaf forbs and grasses. During last decades this species was collected only in two locations. It is also rare in the forest-steppes on the left side of the Ob River, but in the Altay Mts., *A. fusca* may be very abundant locally. Evident downgrading of species populations in the region can be associated with intensive agricultural activity and the following destruction of meadows along forest edges.

Tribe Dociostaurini Mistshenko, 1974
Genus *Notostaurus* Bey-Bienko, 1933

***Notostaurus albicornis* (Eversmann, 1848)**
White-headed cross-backed grasshopper
Figure 5

General distribution. From SE European Russia and the Caucasus to SE West Siberia and W Mongolia, Iran (the northern parts and Zagros), N Afghanistan.

Local distribution and ecology. This species was (and is) distributed over the dry steppes in the south-western part of the region. Its rare populations are associated with short scarce vegetation on clay soils. It is relatively common in the semi-deserts of E Kazakhstan.

Tribe Aulacobothrini Johnston, 1956
Genus *Eremippus* Uvarov, 1926

***Eremippus simplex* (Eversmann, 1859)**
Kazakhstan grasshopper
Figure 6

General distribution. SE European Russia, Kazakhstan (except the northern part), SE West Siberia, NW China, W Mongolia, S Tuva, Turkmenistan, Uzbekistan, Kyrgyzstan, NE Iran, NW Afghanistan.

Local distribution and ecology. This species was (and is) distributed over the dry steppes in the south-western part of the region. Its rare populations are associated with the very dry steppe habitats. Its populations may be abundant in the semi-deserts and north deserts of Kazakhstan.

Tribe Stenobothrini Harz, 1975
Genus *Stenobothrus* Fischer, 1853

***Stenobothrus carbonarius* (Eversmann, 1848)**
Dark toothed grasshopper
Figure 7

General distribution. SE European Russia, Kazakhstan, S Siberia (up to Buryatia); probably NW China and N Mongolia.

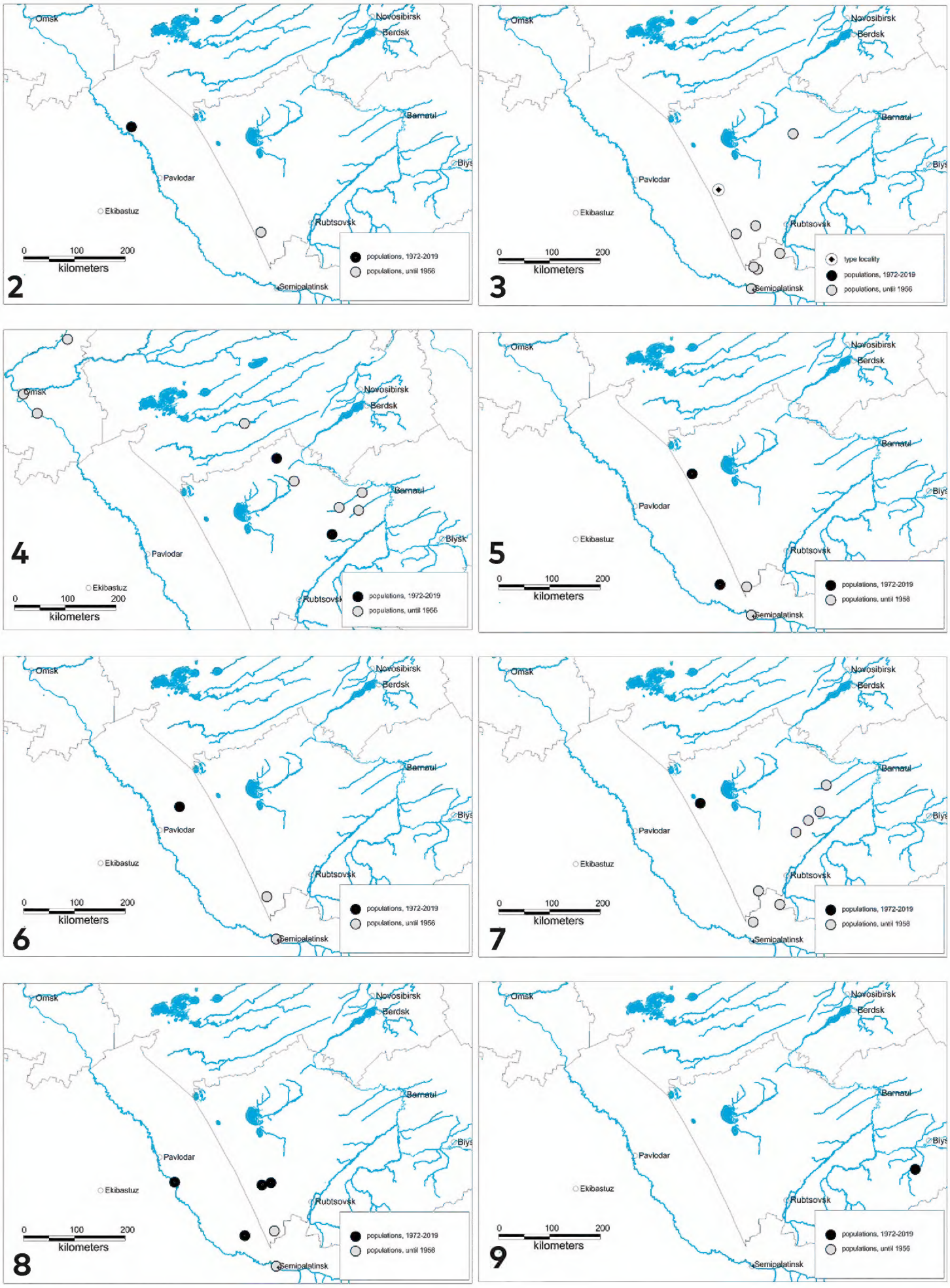
Local distribution and ecology. In the first half of the 20th century this rare species was found in many localities, mainly in the typical and dry steppes of the southern part of the region. The Dark toothed grasshopper is usually associated with the dry steppes. During last decades it was found only near Tabuny settlement in the central part of the Kulunda steppe, but in both 2004 and 2006 its average population density here was 0.32/m^2.

Genus *Myrmeleotettix* I. Bolívar, 1914

***Myrmeleotettix antennatus* (Fieber, 1853)**
Long-horned club grasshopper
Figure 8

General distribution. Europe (except the northern parts), N Caucasus, Kazakhstan (except the south-western and southernmost parts), S West Siberia.

Local distribution and ecology. The rare populations of this species occured (and occur) only in the dry sandy steppe habitats (often together with *Mesasippus arenosus* (Bey-Bienko, 1930)). In 2004–2006 the average population density varied between 0.64 and 1.28/m^2 (near Rakity settlement, Kulunda steppe). In the southern part of the Kulunda steppe, in 1972 the similar density (about 0.5/m^2) was reg-



Figures 2–9. 2 – *Asiotmethis muricatus*. **3** – *Asiotmethis jubatus*. **4** – *Arcyptera fusca*. **5** – *Notostaurus albicornis*. **6** – *Eremippus simplex*. **7** – *Stenobothrus carbonarius*. **8** – *Myrmeleotettix antennatus*. **9** – *Megaulacobothrus aethalinus*.

istered near Jamyshevo settlement on the right side of the Irtysh River, however, the same parameter was relatively low (about 0.05/m^2) near Beskaragaj (Bolshaja Vladimirovka) settlement.

Genus *Megaulacobothrus* Caudell, 1921

Megaulacobothrus aethalinus (Zubovsky, 1899)
Figure 9

General distribution. S Siberia (from the N Altay Mts. and their piedmont plains up to Dauria), E Kazakhstan, S Russian Far East, NE China, Korea.

Local distribution and ecology. In the Altay-Sayan Mts., the species is commonly associated with bushes and high meadows on the lower altitudinal belts of mountains. It was mentioned from the south-eastern edge of West Siberian Plain, on the so-called Anuy Ouval, for the first time by Sergeev (2013).

Tribe Gomphocerini Fieber, 1853
Genus *Gomphocerippus* Roberts, 1941

Gomphocerippus rufus (Linnaeus, 1758)
Rufous or White-clubbed grasshopper
Figure 10

General distribution. Europe (except the extreme North), Siberia (except the extreme North and NE parts), N Caucasus; W Kazakhstan, Amur Region, NE China.

Local distribution and ecology. Berezhkov (1956) noted that the Rufous grasshopper was relatively rare in the forest-steppes and steppes. Nowadays its populations are also rare in the region. In 2019 the population density was about 0.1/m^2 (a meadow near Neudachino settlement in the Baraba steppe). However, this species is relatively abundant in meadows and along edges of the birch forests on the right side of the Ob River.

Genus *Aeropedellus* Hebard, 1935

Aeropedellus variegatus (Fischer de Waldheim, 1846)
Alpine thick-necked grasshopper
Figure 11

General distribution. N Europe, mountains of S Europe, N Caucasus, Siberia, Far East (the northern parts), Kazakhstan (except the southern parts), Mongolia.

Local distribution and ecology. A few specimens were observed in the forest-steppes on the left side of the Ob River. The species is common in the different mountain steppes of the Altay-Sayan Mts., from the alpine ones to the dry steppes on piedmont plains of intermountain basins and to the semi-deserts.

Remarks. Actually almost all specimens from the Kulunda steppe represent *Aeropedellus baliolus* Mistshenko, 1951.

Genus *Mesasippus* Serg. Tarbinsky, 1931

Mesasippus arenosus (Bey-Bienko, 1930)
Figure 12

General distribution. SE West Siberia (dry steppes), E Kazakhstan.

Local distribution and ecology. The species was described as *Chorthippus kozhevnikovi arenosus* Bey-Bienko from the vicinities of Aul settlement, Semipalatinskij District (now in the East Kazakhstan Province, Kazakhstan) (Bey-Bienko, 1930b). The rare populations of this species occured (and occur) only in the dry sandy steppe habitats (often together with *M. antennatus*). In 2004–2006 the average density of one population varied between 0.16 and 1.32/m^2 (dry sandy steppe, near Rakity settlement, Kulunda steppe).

Subfamily Locustinae W. Kirby, 1825 (= Oedipodinae F. Walker, 1871)
Tribe Parapleurini Brunner von Wattenwyl, 1893
Genus *Mecostethus* Fieber, 1852

Mecostethus parapleurus (Hagenbach, 1822)
Leek grasshopper
Figure 13

General distribution. Europe (except the northern parts), Asia Minor, Caucasus, Kazakhstan, S Siberia, S Russian Far East, NE China, Korea, Japan, NW Iran, Central Asia.

Local distribution and ecology. In S Siberia, the Leek grasshopper was (and is) distributed very locally. Its populations are usually associated with grass meadow along rivers, but on the Anuy Ouval (near Sychevka settlement) it was found in the meadow steppe with some high grasses, forbs, and bushes (together with *M. aethalinus* and *G. rufus*).

Tribe Locustini W. Kirby, 1825
Genus *Locusta* Linnaeus, 1758

Locusta migratoria Linnaeus, 1758
Migratory locust
Figure 14

General distribution. The most widely distributed acridid species. Its ranges includes almost all Eurasia (except the North), Africa, Australia and many islands. The nominotypical subspecies is mainly distributed over the extra-tropical regions of Eurasia. The Migratory locust is one of the most important transboundary pest

in many tropical and subtropical countries of Old World and of the southern parts of temperate Eurasia too.

Local distribution and ecology. In the first half of the 20th century adults of the Migratory locust have been found in many places in the southern part of West Siberian Plain (up to the southern taiga). However, these specimens were mainly originated from South-East Kazakhstan (Berezhkov 1956) where some permanent habitat areas of this species were near Zaisan and Balkhash lakes and near the system of Alakol lakes and where upsurges could start. The adults and their swarms could migrate from these areas northward. However, at least several stable populations were known in the south-eastern part of the Plain. They could be recognized by common presence of larvae and young undamaged adults (Wnukowskij 1926). Nowadays arrivals of swarms become very rare but at least several populations of the Migratory locust exist in the region (Sergeev 2017). They are mainly associated with the typical habitats of the species, namely reed beds. Unfortunately, such habitats are not suitable for studies. As a result, solitarious locusts may be often missed during collecting trips.

Tribe Sphingonotini Johnston, 1956

Genus *Sphingonotus* Fieber, 1852

Sphingonotus coerulipes Uvarov, 1922

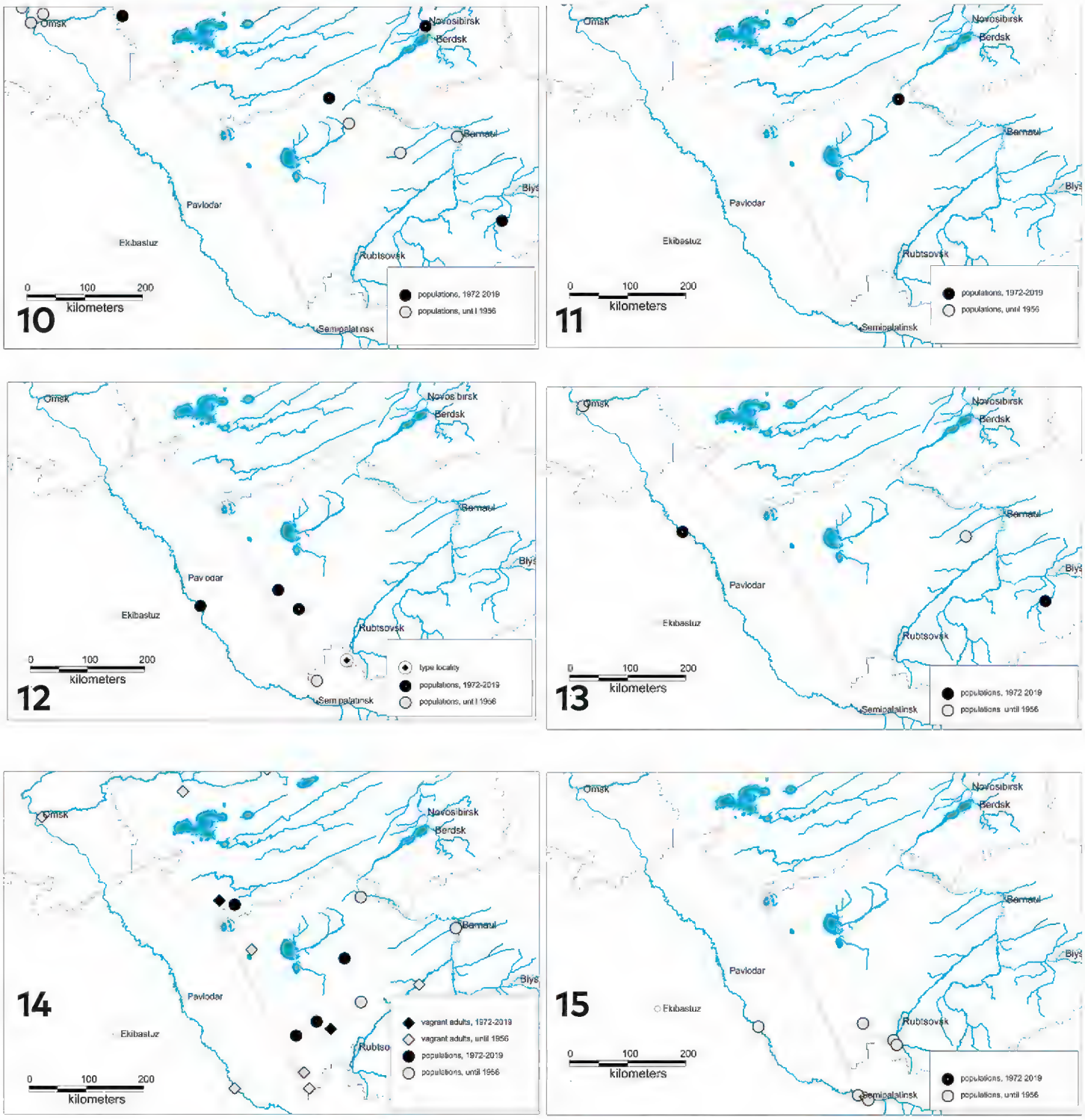
Blue-legged sand grasshopper
Figure 15

General distribution. From SE Europe and Asia Minor to SE West Siberia and W Mongolia, N Iran.

Local distribution and ecology. In the first half of the 20th century *S. coerulipes* was more or less common in the southern part of the Kulunda steppe (Berezhkov 1956). The species is absent in our collections from the region, but it is relatively common in the semi-deserts of E and C Kazakhstan. It prefers habitats with scarce vegetation in the typical and dry steppes (commonly with some sagebrushes and on sandy soils) and some similar stony habitats in the mountain semi-deserts. Some habitats of this species could be destroyed or damaged during the co-called Virgin Lands campaign in the middle of the 20th century when huge steppe areas have been ploughed and many steppe remains have become overgrazed.

Conclusion

In the Baraba and Kulunda steppes, the rare species of grasshoppers comprise about 24 % of local acridid fauna (14 species from 59) (Berezhkov 1956; Sergeev 1986). Two rare forms represent the family Pamphagidae and 12 species are from the fam-



Figures 10–15. 10 – *Gomphocerippus rufus*. **11** – *Aeropedellus variegatus*. **12** – *Mesasippus arenosus*. **13** – *Mecostethus parapleurus*. **14** – *Locusta migratoria*. **15** – *Sphingonotus coerulipes*.

ily Acrididae. There are no endemic grasshopper species, but the ranges of two taxa are limited by the Kulunda steppe and the adjacent semi-deserts of East Kazakhstan (*Asiotmethis jubatus* and *Mesasippus arenosus*). The type localities of both species are in the Kulunda steppe.

The distribution patterns of several species, namely *Asiotmethis muricatus*, *Notostaurus albicornis*, *Eremippus simplex*, *Myrmeleotettix antennatus*, *Gomphocerippus rufus*, *Mesasippus arenosus*, *Mecostethus parapleurus*, *Locusta migratoria*, did not change significantly. Two species, namely *Megaulacobothrus aethalinus* and *Aeropedellus variegatus*, were recently found near the south-eastern and north-eastern boundaries of the region. Four taxa (*Asiotmethis jubatus*, *Arcyptera fusca*, *Stenobo-*

thrus carbonarius, *Sphingonotus coerulipes*) were relatively often in the first half of 20th century, but nowadays they are extremely rare. Some serious problems with the last species group may be explained by some destruction or transformation of many habitats during the Virgin Land campaign in the middle of the 20th century when huge steppe areas have been ploughed and many steppe and meadow remains have become overgrazed. In any case, the local populations of almost all rare species are usually associated with a few types of habitats. This means that intensification and changes of human activity (inculding pest control during grasshopper and locust upsurges) may result in their elimination. A simple red-listing of rare grasshoppers is not enough in almost all cases, because nobody may control their populations. We should modify conservation strategy for grasshoppers, especially in the grasslands, with much more emphasis on conserving whole ecosystems and landscapes. As a result, pest management protocols should incorporate data concerning rare species populations and their habitats/ecosystems to avoid the extinction.

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The authors have declared that no competing interests exist.

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Appendix 1

Table A1. Localities of rare grasshoppers (Insecta, Orthoptera, Acrididae) dustribution in the Baraba and Kulunda steppes (South Siberia)

Species	Period	N / E	Remarks
Aeropedellus variegatus	1972–2019	53.85, 81.22	
Arcyptera fusca	1900–1950	53.33, 82.98	
	1900–1950	53.03, 82.88	
	1900–1950	53.52, 81.07	
	1900–1950	53.08, 82.33	
	1900–1950	54.97, 73.48	
	1900–1950	55.88, 74.72	
	1900–1950	54.48, 79.68	
	1900–1950	54.65, 73.87	
	1972–2019	53.9, 80.58	
	1972–2019	52.63, 82.13	
Asiotmethis jubatus	1900–1950	51.52, 80.35	
	1900–1950	51.05, 81.03	
	1900–1950	52.12, 79.32	Type locality
	1900–1950	53.08, 81.4	
	1900–1950	50.45, 80.23	
	1900–1950	50.78, 80.4	
	until 1956	50.82, 80.3	
	until 1956	51.38, 79.8	
Asiotmethis muricatus	until 1956	51.38, 79.8	
	1972–2019	53.17, 76.17	
Eremippus simplex	until 1956	50.93, 80.1	
	until 1956	50.45, 80.23	
	1972–2019	52.7, 77.52	
Gomphocerippus rufus	until 1956	53.32, 83.73	
	until 1956	53.52, 81.07	
	until 1956	55.15, 73.55	
	until 1956	55.25, 73.03	
	until 1956	55.02, 73.25	
	until 1956	53.08, 82.33	
	1972–2019	53.9, 80.58	
	1972–2019	55.12, 75.5	
	1972–2019	54.97, 82.95	
	1972–2019	52.07, 84.83	
Locusta migratoria	until 1956	53.32, 83.73	Stable population
	until 1956	53.78, 81.37	Stable population
	until 1956	50.45, 80.23	Stable population
	until 1956	52.22, 81.38	Stable population
	until 1956	50.93, 80.1	Vagrant specimen(s)
	until 1956	54.97, 73.48	Vagrant specimen(s)
	until 1956	55.35, 76.97	Vagrant specimen(s)

Species	Period	N / E	Remarks
Locusta migratoria	until 1956	55.68, 79.05	Vagrant specimen(s)
	until 1956	51.17, 79.97	Vagrant specimen(s)
	until 1956	53, 78.67	Vagrant specimen(s)
	until 1956	52.48, 82.82	Vagrant specimen(s)
	until 1956	50.93, 78.25	Swarms
	1972–2019	51.93, 80.28	Stable population
	1972–2019	53.67, 78.25	Stable population
	1972–2019	52.87, 80.97	Stable population
	1972–2019	51.72, 79.77	Stable population
	1972–2019	53.73, 77.87	Vagrant (?) specimen
	1972–2019	51.82, 80.63	Vagrant (?) specimen
Mecostethus parapleurus	until 1956	53.03, 82.88	
	until 1956	54.97, 73.48	
	1972–2019	53.1, 75.92	
	1972–2019	52.07, 84.83	
Megaulacobothrus aethalinus	1972–2019	52.07, 84.83	
Mesasippus arenosus	until 1956	51.05, 81.03	Type locality
	until 1956	50.75, 80.28	
	1972–2019	52.12, 79.32	
	1972–2019	51.83, 79.83	
	1972–2019	51.88, 77.38	
Myrmeleotettix antennatus	until 1956	51.05, 80.18	
	until 1956	50.45, 80.23	
	1972–2019	51.88, 77.38	
	1972–2019	50.97, 79.35	
	1972–2019	51.87, 80.08	
	1972–2019	51.83, 79.83	
Notostaurus albicornis	until 1956	50.93, 80.1	
	until 1956	50.45, 80.23	
	1972–2019	52.85, 78.57	
	1972–2019	50.97, 79.35	
Sphingonotus coerulipes	until 1956	51.27, 81.1	
	until 1956	51.2, 81.18	
	until 1956	51.52, 80.35	
	until 1956	51.47, 77.78	
	until 1956	50.38, 80.48	
	until 1956	50.45, 80.23	
Stenobothrus carbonarius	until 1956	52.28, 81.48	
	until 1956	52.48, 81.83	
	until 1956	52.63, 82.15	
	until 1956	51.05, 81.03	
	until 1956	53.08, 82.33	
	until 1956	50.75, 80.28	
	until 1956	51.28, 80.43	
	1972–2019	52.77, 78.8	